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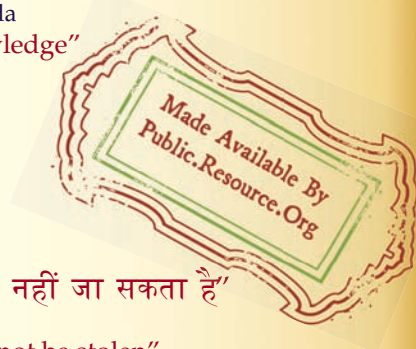
IS 9494 (1980): Man-Riding Cars Used in Mines [MED 8:
Mining Techniques and Equipment]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

(Reaffirmed 2005)

SPECIFICATION FOR MAN-RIDING CARS USED IN MINES

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Gr 8

1. Scope — Covers the requirements for man-riding mine cars used for conveyance of men on conventional rail track in underground mineworkings or quarries using either rope or locomotive haulage.

2. Terminology

2.1 Coupling Line — In flat faced buffer-couplings, this is the buffer face. In couplings which inter-penetrate it is the plane half-way between the two pivot pins when a pair of couplings are coupled up.

2.2 Line of Coupling Thrust — The line drawn through the pivot pin centres of a pair of engaged couplings, and projected (see Fig. 5). This line reaches maximum obliquity on a pair of vehicles negotiating a reverse curve.

2.3 Pivot Pin — The fulcrum which allows horizontal swinging of the coupling head in relation to the car chassis.

2.4 Shank Length — The length along the axis of the coupling from the pivot pin to the coupling line.

2.5 Standout — The distance by which the coupling line stands out from end of the car body, with draw-springs uncompressed.

2.6 Train — A number of cars coupled together.

2.7 End Throw — The distance by which a point at the end of a car, on the vehicle centre line, moves horizontally towards one side of the centre line of the track when the latter is curved.

3. Seating Arrangement

12 in 6 seats of 2 abreast
16 in 8 seats of 2 abreast
18 in 6 seats of 3 abreast
24 in 8 seats of 3 abreast

3.1 Capacity of cars with 3 seats abreast may be reduced by 2 seats in case of low height cars.

3.2 For smaller lengths of cars, the number of compartments can be reduced (reducing the seating capacity of cars) by one keeping the ratio of overall length to wheel base as specified in 6.1.5.

4. Dimensions — As specified in Fig. 1 to 4 read with Table 1.

5. Material — As specified in Table 2.

5.1 Unless agreed between the manufacturer and the purchaser, no component of man-riding car shall be made of aluminium, magnesium or titanium subject to statutory restrictions.

5.1.1 Plates and extruded sections of aluminium, when used, shall conform to HS20-WP or HS30-WP of IS : 737-1974 'Wrought aluminium and aluminium alloys, sheet and strip (for general engineering purposes) (*second revision*)' and HE30-WP of IS : 733-1975 'Wrought aluminium and aluminium alloy, bars, rods and sections (for general engineering purposes) (*second revision*)'.

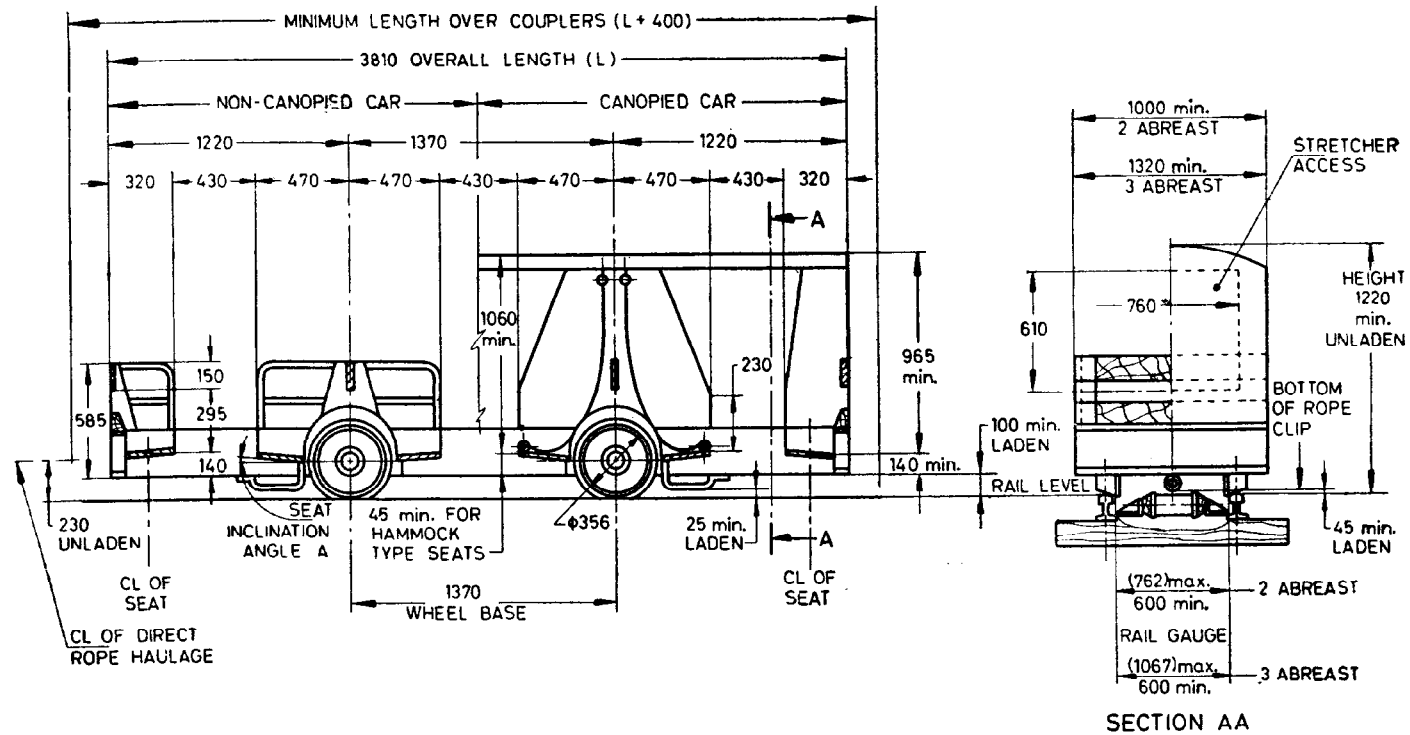
5.1.1.1 Components made of aluminium shall not be welded and rivets when used shall be of NR6 or HR30 alloys of IS : 740-1966 'Wrought aluminium and aluminium alloys, rivet stock (for general engineering purposes) (*revised*)'.

5.1.1.2 When aluminium and steel are combined, these shall be insulated from each other by bitumen paint or zinc chromate primer to avoid galvanic corrosion. If steel rivets are used a coat of zinc chromate primer shall be applied to the aluminium before riveting.

5.1.2 No component shall be painted or coated with preparation containing aluminium, magnesium or titanium in metallic form.

5.2 In case of natural rubber, the compound shall consist of base elastomer and carbon black, together with necessary curing and processing agents. The rubber shall be free from reclaim crumb or inorganic filler and shall be compounded for good resilience and low set characteristics.

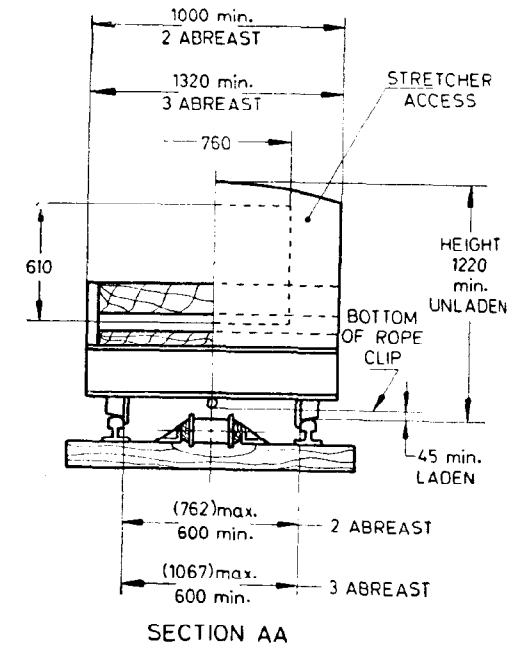
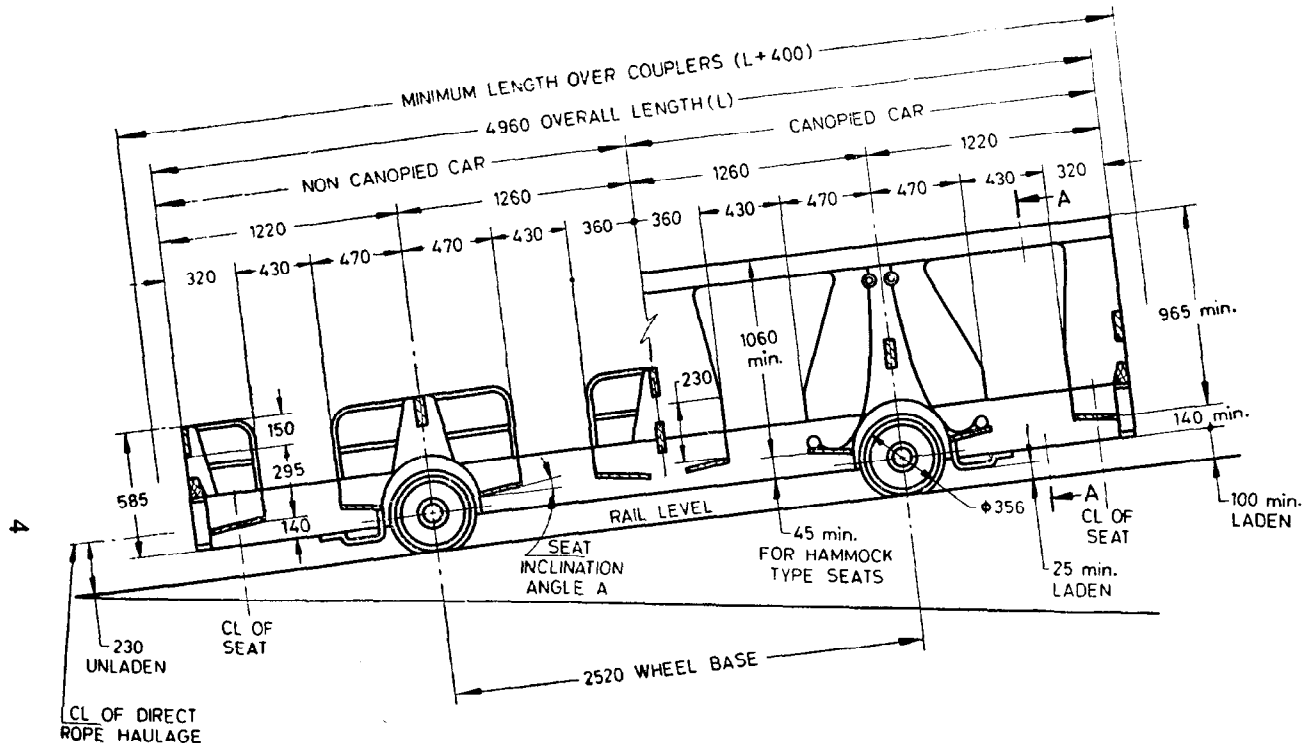
5.2.1 Springs made of rubber shall be oil and acid resistant.



Gradient	Angle A	Car Designation	
		2 Abreast	3 Abreast
Level to 1 in 6	5°	1L6-2/12	1L6-3/16
1 in 5 to 1 in 3	12°	1L3-2/12	1L3-3/16

All dimensions in millimetres.

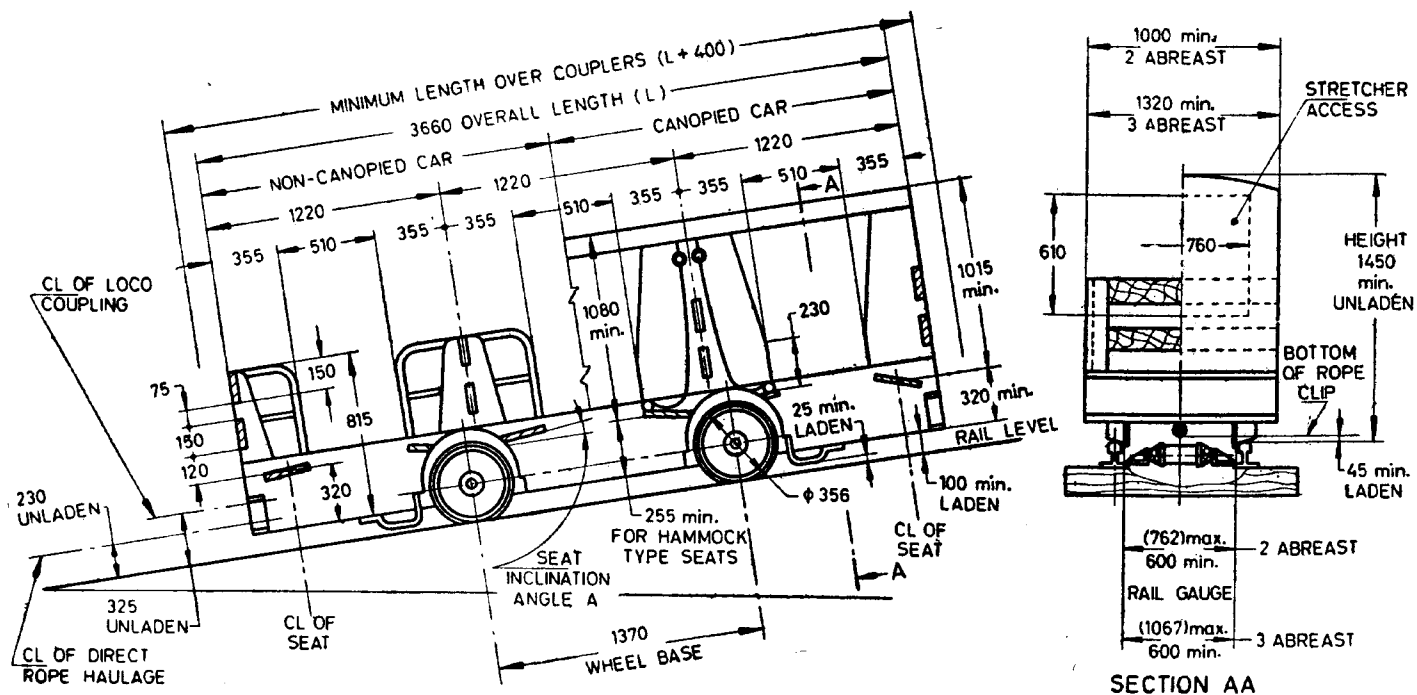
FIG. 1 LOW HEIGHT CARS — 12/16 SEATS



Gradient	Angle A	Car Designation	
		2 Abreast	3 Abreast
Level to 1 in 6	5°	2L6-2/16	2L6-3/22
1 in 5 to 1 in 3	12°	2L3-2/16	2L3-3/22

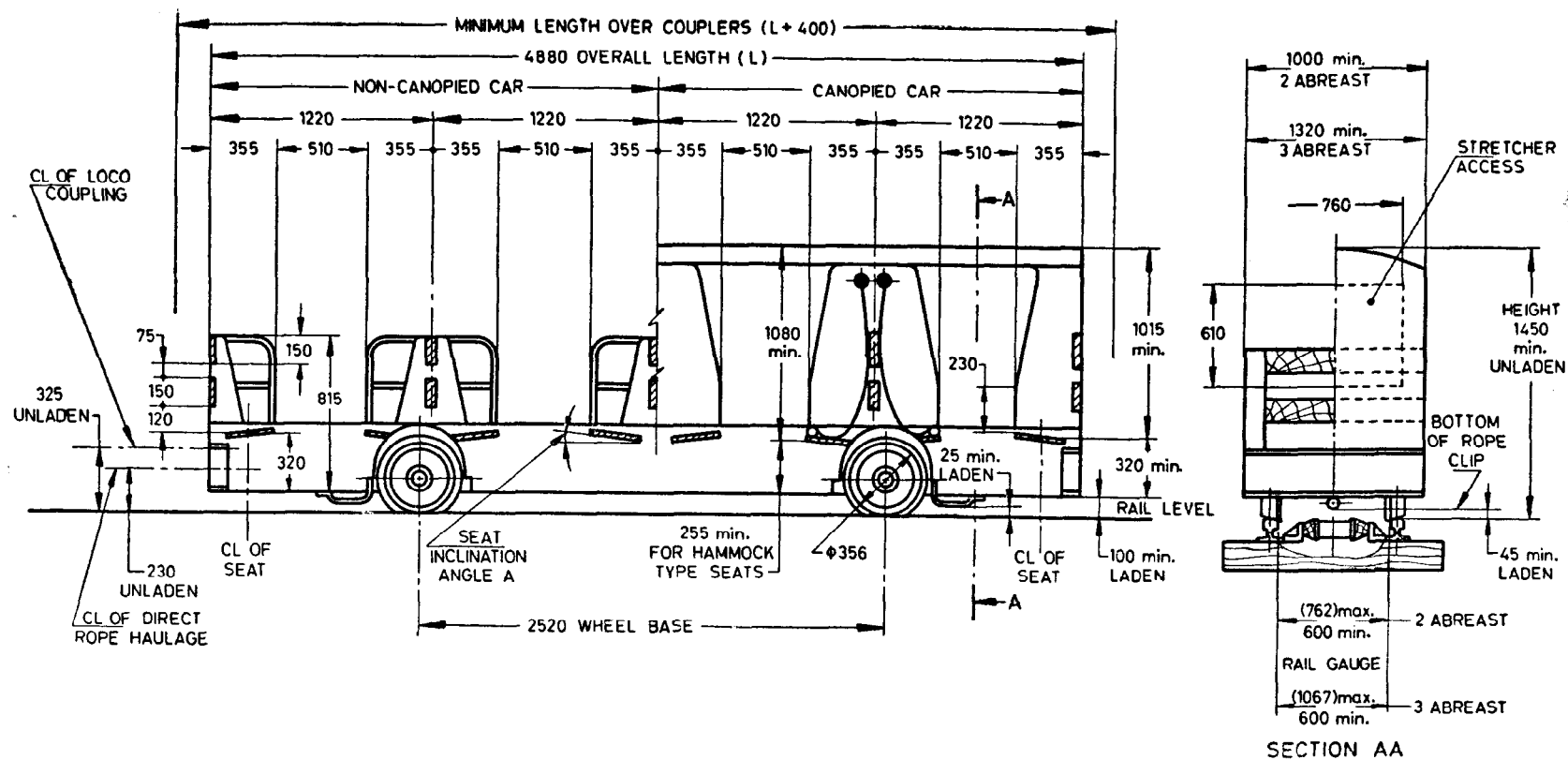
All dimensions in millimetres.

FIG. 2 LOW HEIGHT CARS — 16/22 SEATS



Gradient	Angle A	Car Designation	
		2 Abreast	3 Abreast
Level to 1 in 6	5°	3N6—2/12	3N6—3/18
1 in 5 to 1 in 3	12°	3N3—2/12	3N3—3/18

All dimensions in millimetres.



Gradient	Angle A	Car Designation	
		2 Abreast	3 Abreast
Level to 1 in 6	5°	4N6-2/16	4N6-3/24
1 in 5 to 1 in 3	12°	4N3-2/16	4N3-3/24

All dimensions in millimetres.

FIG. 4 NORMAL HEIGHT CARS — 16/24 SEATS

TABLE 1 PRINCIPAL DIMENSIONS AND DESIGN FEATURES OF MAN-RIDING CARS

(Clauses 4 and 6.1.11 and Fig. 1 to 4)

Car Designation			Low Height Cars								Normal Height Cars															
			Fig. 1				Fig. 2				Fig. 3				Fig. 4											
			1L6-2/12	1L6-3/16	1L3-2/12	1L3-3/16	2L6-2/16	2L6-3/21	2L3-2/16	2L3-3/22	3N6-2/12	3N6-3/18	3N3-2/12	3N3-3/18	4N6-2/16	4N6-3/24	4N3-2/16	4N3-3/24								
Number of Seats			12		16		12		16		12		18		12		18		16		24		16		24	
Design Gradient			Level to 1 in 6		1 in 5 to 1 in 3		Level to 1 in 6		1 in 5 to 1 in 3		Level to 1 in 6		1 in 5 to 1 in 3		Level to 1 in 6		1 in 5 to 1 in 3		Level to 1 in 6		1 in 5 to 1 in 6					
Rail data	Vertical curve, minimum radius, m		30		30		50		50		30		30		50		50									
	Horizontal curve, minimum track centre radius, m		25		25		30		30		25		25		30		30									
	Rail gauge range, mm	min max	600 (762) (1 067)		600 (762) (1 067)		600 (762) (1 067)		600 (762) (1 067)		600 (762) (1 067)		600 (762) (1 067)		600 (762) (1 067)		600 (762) (1 067)									
Approximate weight, kg	Trailer car, hydraulic brake		1 070	1 245	1 070	1 245	1 170	1 400	1 170	1 400	1 090	1 270	1 090	1 270	1 200	1 420	1 200	1 420								
	Master car, hydraulic brake		1 170	1 350	1 170	1 350	1 295	1 525	1 300	1 525	1 200	1 375	1 200	1 375	1 320	1 550	1 320	1 550								
	Air-braked car		1 370	1 625	Not applicable		1 525	1 780	Not applicable		1 400	1 650	Not applicable		1 550	1 800	Not applicable									
Overall length of chassis, L, mm			3 810		3 810		4 960		4 960		3 660		3 660		4 880		4 880									
Length over couplers, min, mm			L + 400		L + 400		L + 400		L + 400		L + 400		L + 400		L + 400		L + 400									
Overall height, min, unladen, mm			1 220		1 220		1 220		1 220		1 450		1 450		1 450		1 450									
Overall width, mm	2 abreast		1 000		1 000		1 000		1 000		1 000		1 000		1 000		1 000									
	3 abreast		1 320		1 320		1 320		1 320		1 320		1 320		1 320		1 320									
Wheelbase, mm			1 370		1 370		2 520		2 520		1 370		1 370		2 520		2 520									
Compartment centres	Between wheel-base, mm		1 370		1 370		1 260		1 260		1 220		1 220		1 220		1 220									
	Outside wheel-base, mm		1 220		1 220		1 220		1 220		1 220		1 220		1 220		1 220									
Seat details	Distance between seats, mm		430		430		430		430		510		510		510		510									
	Seat inclination, A		5°		12°		5°		12°		5°		12°		5°		12°									
	Height floor to rigid type seat, min, mm		140		140		140		140		320		320		320		320									
	Height floor to hammock type seat, min, mm		45		45		45		45		255		255		255		255									
	Height rigid type seat to canopy, min, mm		965		965		965		965		1 015		1 015		1 015		1 015									
	Height-hammock type seat to canopy, min, mm		1 060		1 060		1 060		1 060		1 080		1 080		1 080		1 080									
Coupling height, unladen, mm	Locomotive haulage		325		Not applicable		325		Not applicable		325		Not applicable		325		Not applicable									
	Rope haulage		230		230		230		230		230		230		230		230									
Track clearance, min, laden, mm	Chassis*		100																							
	Brakes		25																							
Rope clip height, rail to bottom of clip, min, laden, mm			45																							
End door aperture, mm			760 × 610																							

*Applies to all fittings except rope clips.

Note — These dimensions have been determined giving due regard to imitations of roadways, etc.

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TABLE 2 MATERIALS FOR COMPONENTS OF MAN-RIDING CARS
(Clause 5)

SI No.	Component	Material Conforming to
1	Underframe (chassis)	IS : 226-1975 ' Structural steel (standard quality) (fifth revision) ' or equivalent
2	Canopies	IS : 226-1975, or Fire resistant (after curing) glass reinforced plastics
3	Seats and backrests	Fireproofed hardwood or other suitable material which is rot, vermin- and fire-resistant and having antistatic properties which does not produce static electricity
4	Suspension gear i) Horn guides and axle support ii) Suspension units incorporating rubber iii) Laminated springs iv) Volute and helical springs	IS : 226-1975, or, IS : 1030-1975 ' Carbon steel castings for general engineering purposes (second revision) ' or IS : 4588-1975 ' Raw natural rubber (first revision) ' or synthetic material or combination of two IS : 3885 (Part I)-1976 ' Steel for the manufacture of laminated springs (railway rolling stock): Part I Flat sections ' or IS : 3885 (Part II)-1969 ' Steel for the manufacture of laminated springs (railway rolling stock): Part II Rib and groove sections ' IS : 3195-1965 ' Steel for the manufacture of volute and helical springs (for railway rolling stock)
5	Couplings i) Cast components (stressed) ii) Forged components (stressed) iii) Forged components (non stressed) iv) Non stressed components and other than (iii) above v) Springs	IS : 2708-1973 ' 1.5-percent manganese steel castings (first revision) ' or equivalent with min tensile strength of 620 N/mm ² 27Mn2 or 37Mn2 of IS : 1570-1967 ' Schedules for wrought steels for general engineering purposes ' or equivalent with min tensile strength of 770-1 080 N/mm ² C40 of IS : 1570-1967 or equivalent C20 of IS : 1570-1967 or equivalent IS : 3195-1965, or IS : 3885 (Part I)-1966, or IS : 3885 (Part II)-1969, or IS : 4588-1975 or synthetic material
6	Brake shoe (without liner)	Grade 15 of IS : 210-1970 ' Grey iron castings (second revision) '
7	Brake shoe (with liner) i) Shoe ii) Liner	IS : 1030-1974 ' Carbon steel castings for general engineering purposes (second revision) ' Grade 15 of IS : 210

6. General Requirements

6.1 Cars

6.1.1 Canopied cars shall be provided with closed sides of following widths when measured at a height of 230 mm from the seat level:

- a) Between each compartment : 610 mm
- b) At each end of car : 305 mm

6.1.1.1 In case of reversible hammock type seats, the minimum distance between each row of seats shall be 585 mm made up of closed sides of 150 mm and minimum opening of 435 mm.

6.1.2 Canopied cars, shall be provided with apertures on both sides unless otherwise specified. Where apertures on one side only are provided, provision shall be made for the ready removal, from both inside and outside, and without assistance from the other side of the wall, of sufficient panelling on the opposite side of the car to allow easy release of injured men, should the car overturn on to the side that contains the normal doorways.

6.1.3 On all designs of canopied cars access shall be provided, through at least one side, for a stretcher carrying an injured person. Seat backrests may be removable to allow for this. Where required, access may also be provided in the car end(s).

6.1.4 On open-type cars arm protection shall be provided, extending not less than 305 mm from the back of and 230 mm above the seat.

6.1.5 The wheelbase shall be not less than 36 percent of the body length.

6.1.6 End throw of car body on the sharpest curve shall not exceed 100 mm.

6.1.7 The suspension shall be such as to cater for a maximum local rail depression of 50 mm, at any single wheel, when unladen, without the tread of any wheel leaving the rail.

6.1.8 The design shall be such that, if the car is fully loaded at one end, overhanging one axle, and empty elsewhere, there shall be transmitted to the rails, at the remaining axle, a vertical static force of not less than 25 percent of the tare weight of the car.

6.1.9 The design shall be such that, if the car is fully loaded down one side only, overhanging two wheels, there shall be transmitted to the rails at the opposite side of the car a vertical static force of not less than 25 percent of the tare weight of the car.

Note — For the purposes of 6.1.8 and 6.1.9, unless otherwise agreed between the purchaser and the supplier, the design shall be based on passengers each weighing 76 kg.

6.1.10 Unless otherwise agreed between the purchaser and the manufacturer, the height of the centre line of the coupling from the level rail shall be as follows:

Condition of Cars	Coupling Height	
	Normal Height Cars	Low Height Cars
Unladen (max)	325 mm	230 mm
Fully laden (min)	280 mm	210 mm

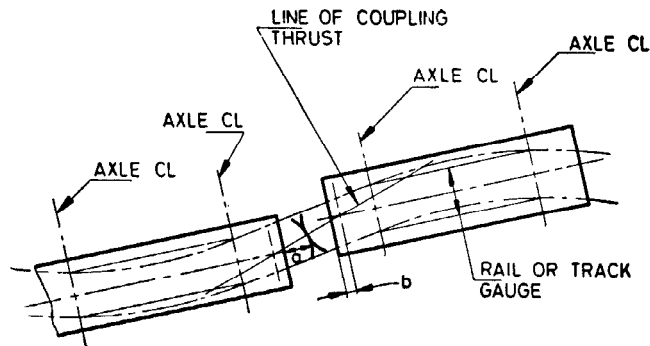
6.1.11 The length and articulation of the couplings shall be such that, when cars are coupled on track, that is, within the parameters laid down in Table 1:

- a) the line of coupling thrust shall intersect with the rail gauge beyond the vertical plane of the adjacent axle of each car (see Fig. 5), and
- b) the couplings shall not exceed the limits of their articulation.

Note — In examining this requirement, clearances between wheel and rail, frame and axlebox, etc, need not be taken into account.

6.2 Chassis

6.2.1 The chassis shall be basically rectangular in shape with bolted, riveted or welded construction and shall be so designed that there are no sharp edges or projections liable to cause personal injury.



a = Coupler projection from car end to coupling line = 170 mm min.
(standard length 200 mm).

b = Length of coupling from car end to pivot centre = 70 mm min.

FIG. 5 RELATIONSHIP BETWEEN CARS, COUPLINGS AND THRUST LINE.

6.2.1.1 Where there is need to provide for cars being transversely split in two halves, the joint shall be adequate for the strength requirements of the chassis.

6.2.2 The chassis shall be designed to withstand the following loadings:

- a) An ultimate tensile load of not less than 10 times the maximum static force down the maximum gradient but, in any case, not less than 750 kN.
- b) A compressive load of 100 kN.

6.2.3 Each end of each car shall be provided with two anchorages for safety chains or ropes, each having not less than 50 percent of the ultimate strength of the car, that is 375 kN or 5 times the maximum static load down the maximum gradient, whichever is the greater. The anchorages shall be spaced 305 mm on each side of the coupling centre; their height shall be not lower than the centre line of the coupling and not more than 75 mm above it.

6.3 Canopies — If required canopy may be sectionalized and/or detachable. If detachable, positive means shall be provided to secure the canopy to the chassis.

6.4 Seats

6.4.1 Seat slats shall be securely held in position but arranged for easy removal where necessary to give access to brake rigging, etc.

6.4.2 Seats shall be angled to suit the gradient of the roadway, as agreed between the purchaser and the manufacturer. Typical arrangements for varying grades are shown in Fig. 1 to 4.

6.4.3 Where hammock-type seats are used, each shall be suspended between two round mild steel bars or tubes, the upper bar or tube being secured to, but easily released from the canopy.

6.5 Wheel Axle Assemblies — Wheel axle assemblies shall conform to IS: 8003-1976 'Wheel axle assemblies for mine cars'.

6.6 Suspension Units

6.6.1 The man-riding cars shall have one of the following methods of suspension as agreed between the manufacturer and the purchaser:

- a) Steel springs, laminated or helical,
- b) Combination springs of steel and rubber,
- c) Rubber blocks, and
- d) Rubber shear/compression devices.

6.6.1.1 The purchaser shall supply to the manufacturer, at the time of enquiry and order, full details of the track and operating conditions such as gauge, average rail length, gradient, curve radii, acceleration, deceleration, running speeds, and any special operating factors to be catered for in the design (see also Appendix A).

6.6.2 It is recommended that the manufacturer shall, on the information supplied by the purchaser, so design the suspension that the oscillations induced in operation are clear of any critical frequencies. The component parts shall be designed for adequate life in fatigue, due allowance being made for the dynamic loads induced by service conditions.

6.6.3 The design shall be such that in the event of failure of the suspension there shall still remain adequate location to ensure safety.

6.6.4 All component parts shall be interchangeable and be so designed that assembly can be effected without the use of special tools and that maintenance, repairs and replacements may easily be accomplished.

6.6.5 *Steel Laminated Springs*

6.6.5.1 Decarburization of the surface (total plus partial) shall not exceed a depth of 0.25 mm. Total decarburization shall not exceed a depth of 0.05 mm.

6.6.5.2 Each spring leaf shall have a hardness of 410 to 475 *HV*. This shall be checked on the compression side of the leaf.

6.6.5.3 All burrs shall be removed from the ends of each leaf.

6.6.5.4 All rivet holes shall be countersunk on the tension side of each leaf, to a depth of 1.5 mm at 45°.

6.6.5.5 Before the final assembly, the leaf contact faces of laminated steel springs shall be suitably lubricated.

6.6.5.6 Buckles, which shall be of the solid type, shall be hot-pressed on to the springs (simultaneously on all four sides) when assembled, to ensure a tight fit. Any welding shall be confined to the boss only. Rivets shall be countersunk and finished flush, in order that the pedestal stool shall have full bearing area.

6.6.5.7 Where specified by the purchaser and agreed by the manufacturer, the springs shall be given anticorrosive treatment.

6.7 *Brakes*

6.7.1 *General*

6.7.1.1 Each car shall have a braking system that will permit parking of the empty car without the use of external power. Hand brakes where fitted shall be for parking purposes only and shall be so designed and located as to avoid possible injury to the operator.

6.7.1.2 Unless otherwise agreed between the purchaser and the manufacturer, cars shall have a braking system that makes provision for application of the brakes throughout a train:

- a) automatically, should the train divide; and
- b) from the end car(s); or
- c) from the end cars and other cars in the train, if specified by the purchaser.

6.7.1.3 The braking system shall be capable of bringing the car or cars to rest and of holding them on the maximum gradient on which they are to be used from a speed and in a distance as agreed between the purchaser and the manufacturer.

Note 1 — Normally, rope hauled cars employ brakes that skid all or most of the weight of the car and contents, through lined shoes, on the rail, while locomotive-hauled cars employ wheel brakes. In special circumstances, if so ordered, skid brakes may be employed with locomotive haulage, or wheel brakes with rope haulage. Where gradients exceed 20 percent (1 in 5), or where they occur in wet conditions, details shall be given on the order (see Appendix A). Locomotive haulage is not normally used on gradients steeper than 6.67 percent (1 in 15).

Note 2 — On locomotive hauled cars, a train will consist of one or more cars, coupled to a locomotive. On rope hauled cars, a train will consist of one or more master cars (see 6.7.3.6) coupled to one or more trailer cars (see 6.7.3.5).

6.7.1.4 Each car shall be provided with connections for the fitting of a valve for application of the brakes in an emergency and for a pressure gauge that is easily readable and protected from risk of a accidental damage to indicate the pressure within the braking system. When specified by the purchaser, an emergency operating valve and/or pressure gauge shall be fitted in any or all cars.

6.7.1.5 Flexible hose connections between cars shall be, appropriately, as follows unless otherwise agreed between the purchaser and the manufacturer.

- a) *Air brakes* — Self-sealing couplings such as will permit disconnection without loss of air.
- b) *Hydraulic brakes* — Self-sealing couplings shall be fitted in the pressure line but shall not be fitted in the return line.

6.7.1.6 Flexible hose connections between cars shall be so arranged that no part shall interfere with or be affected by the movement of cars, relatively, one to another under the operating conditions specified by the purchaser.

6.7.1.7 The hose and hose coupling shall be of such design and strength as to ensure that, in the event of a train accidentally parting, the hose shall either pull off the coupling or break before the halves of the coupling separate.

6.7.1.8 Isolating cocks shall not be fitted in the main through pipelines of the cars.

6.7.1.9 Dummy couplings or other suitable means shall be provided for the support and protection of the hose couplings when they are not in use.

6.7.1.10 It shall not be possible to interconnect the couplings of the emergency and service air pipelines or of the pressure and return lines of an hydraulic system.

6.7.2 Air operated wheel brakes

6.7.2.1 Air brakes fitted to cars purporting to comply with the requirements of this standard shall operate on a two-pipe system*, that is:

- a) by direct air pipelines from the locomotive compressed air system, when the brakes are applied by the locomotive driver for service braking, and
- b) by emergency pipeline, in the event of a breakaway or parting of the train; or opening, by the passenger, guard or the locomotive driver, of an emergency valve, and using air from the emergency reservoirs provided on each car and the locomotive.

6.7.2.2 Where required by the purchaser, an emergency pipe pressure gauge shall be fitted to any specified car.

6.7.2.3 When brakes are in the 'off' position there shall be a clearance of not less than 1.5 mm between the brake block and wheel tread.

6.7.2.4 Brakes shall be of the fully compensated type, that is, with the rigging so arranged that equal pressure is applied to brake blocks on all wheels.

6.7.2.5 Where a purchaser requires alternative levels of air-braking to suit empty or loaded conditions, the control facility shall be provided on the locomotive and not on individual cars. The control shall change only the emergency brake on the cars and shall not affect the service brake or the locomotive brake.

Note — Where cars that comply with the requirements of this standard are added to existing trains, an examination shall be made of the existing braking systems, to avoid underbraking or overbraking of cars, and incompatibility of equipment between cars, and between cars and locomotives.

6.7.2.6 Air brake pipes shall be so arranged that, when viewing the end of a car from outside, the pipe connectors shall be positioned as follows:

- a) Straight air hose: 215 ± 15 mm to left of car centre
(Root of hose $1\,200 \pm \begin{smallmatrix} 15 \\ 0 \end{smallmatrix}$ mm above rail level).
- b) Emergency hose: 215 ± 15 mm to right of car centre
(Root of hose $1\,065 \pm \begin{smallmatrix} 0 \\ 15 \end{smallmatrix}$ mm above rail level).

*One-pipe system may be acceptable within the standard, subject to agreement between the purchaser and the manufacturer.

6.7.3 Hydraulically operated track brakes

6.7.3.1 Where hydraulically operated track brakes are fitted to cars purporting to comply with the requirements of this standard, each car shall be provided with four brake shoes which, for normal running when loaded, are held not less than 25 mm clear of the track by an hydraulic system, but which are applied to the track whenever the system is exhausted.

6.7.3.2 Means to pressurize the hydraulic system and exhaust it, in the event of overspeed or other emergency, need not be provided on every car, but provision shall be made whereby any car may be connected to another car (master car) having these facilities.

Note— It is recommended that all hydraulic brake circuits be of the closed type (exhaust shall return to reservoir). Where fitted, it shall not be possible to interconnect the pressure and return pipe lines of the hydraulic system. However, an open system may be used where a high speed of application is required, as on steep gradients; the design should be such as to avoid dumped fluid contaminating the track rails.

6.7.3.3 The track brake shoes shall be secured to the underside of the frame of the car, immediately adjacent to each wheel and outside the wheelbase. Liners when used on brake shoes shall be of fire resistant material free from aluminium content and shall be fixed on the body of brake shoes either by rivetting or as agreed between the purchaser and the manufacturer.

6.7.3.4 The cars shall have theoretical stopping distances on dry rails, as given in Fig. 6 when calculated by following formula with varying speeds and gradients for cars fitted with track brakes lined with material having a coefficient of friction of 0.4 on dry rails.

$$S = \frac{U^2}{2g (\mu \cos \theta - \sin \theta)}$$

where

S = Stopping distance, in metres

U = Initial speed in m/sec

g = Gravitational force

μ = Coefficient of friction

θ = Angle of inclination

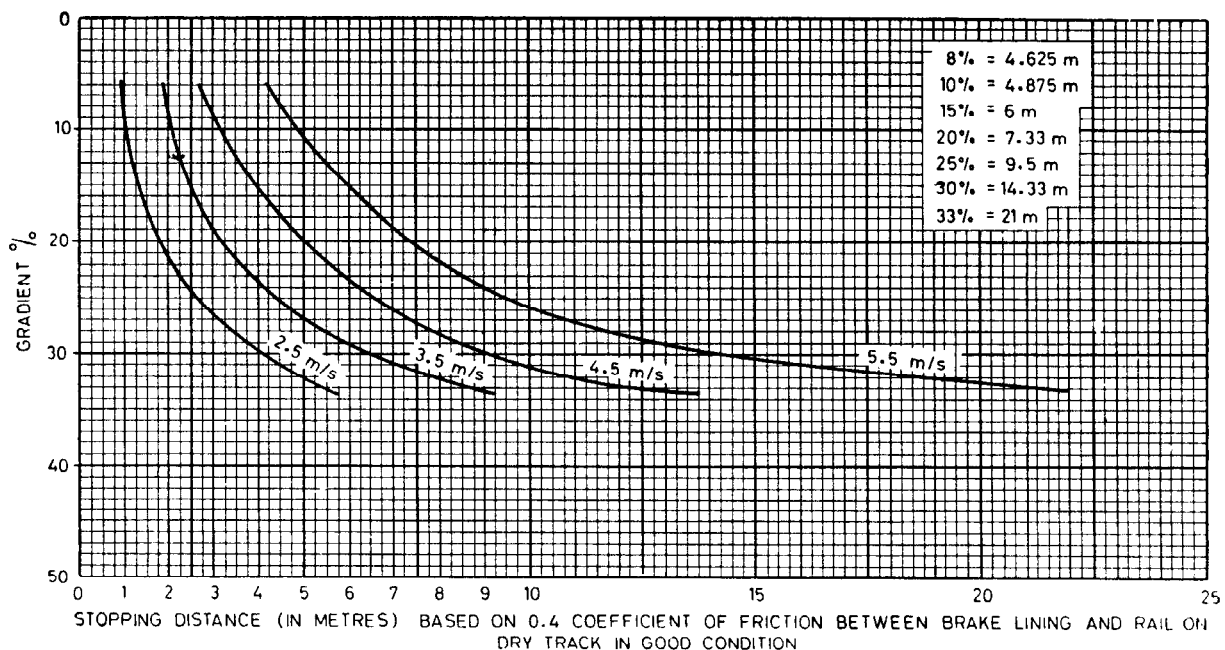


FIG. 6 THEORETICAL STOPPING DISTANCES WITH TRACK BRAKES

6.7.3.5 Cars shall be equipped with provision to fit an emergency operating valve and a pressure gauge and, where required by the purchaser, shall be fitted with an emergency operating valve or pressure gauge, or both.

6.7.3.6 Master cars shall be additionally equipped with the following:

- a) A manually-operated pump for the purpose of generating the required pressure for the master car and any other car to which it may be connected.
- b) A pressure relief valve set to the required operated pressure declared by the manufacturer.
- c) A pressure gauge marked with the normal working pressure declared by the manufacturer.
- d) A manually-operated valve to apply the brakes, in an emergency, on the master car and any other car to which it may be connected.
- e) A governor, positively driven from one rail wheel of the master car, to apply the brakes as nearly as practicable simultaneously to that car and to any other car to which it may be connected, in the event of overspeed in either direction. Such governor shall be capable of being tested up to and above that speed with the car stationary. The speed at which the governor is required to apply the brakes shall be specified by the purchaser.

6.7.3.7 The hydraulic fluid shall be of a type agreed between the purchaser and the manufacturer. It is recommended that the fluid be of the fire resistant type.

6.7.4 Other types of brakes — Alternative forms of wheel, axle or track braking may be developed but are not covered by the requirements of this standard.

6.8 Couplings

6.8.1 Cars shall be so designed as to comply with the strength and other requirements of Appendix B and to ensure that the line of coupling thrust at all times intersects the rectangles enclosed by the wheelbase and rail gauge of each of the vehicles concerned (see **6.1.11** and Fig. 5).

6.8.2 For use with locomotives — Couplings shall be of a type that incorporates a steel or rubber spring to absorb initial shock loads in buffing and hauling, and shall have heads adequately articulated in the horizontal and vertical planes.

6.8.3 For use with haulage — Couplings shall comply with the requirements of **6.8.2** but need not incorporate springs. The couplings shall have adequate articulation, in both horizontal and vertical planes, at their attachment to each vehicle. The movement shall be restricted to prevent jack-knifing in the vertical plane.

6.9 Safety Chains or Ropes — Where chains or ropes are specified they shall be fitted in such a manner and be of such a length that they do not interfere with the free movement of the main couplings, they are clear of the track and remain unstressed under all conditions, other than emergency, that is where there has been a failure of the main coupling gear. The ultimate breaking strength of each safety chain or rope shall be not less than half the ultimate breaking strength of the main coupling.

6.10 Clips for Continuous Rope Haulage

6.10.1 Means shall be provided on each car for attachment of a rope clip fitted on either the draw-gear or the chassis. If agreed between the purchaser and the manufacturer more than one point of attachment for a rope clip may be provided.

6.10.1.1 Where required by the purchaser, the car manufacturer shall provide a certificate, issued by the rope clip manufacturer, stating the maximum load that the clip will transmit without slip when tightened in accordance with the manufacturer's instructions and tested on a rope in dry condition and of identical construction to the rope specified for the installation.

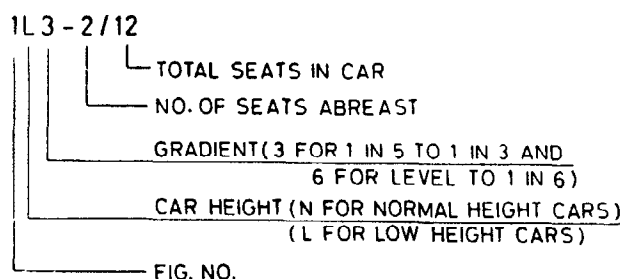
Note — The total transmission strength of all clips applied to secure a train to the rope of a haulage system shall be as agreed between the purchaser and the manufacturer.

6.10.2 Clearance — The clearance between the rail and the bottom of the clip when the car is fully laden shall be not less than 45 mm or as otherwise agreed between the manufacturer and the purchaser. In determining this clearance cognizance shall be taken of the installed height of rails and other equipment located within the track.

7. Designation — A low height man-riding car conforming to dimensions specified in Fig. 2 suitable for gradient of 'level to 1 in 6' with a total capacity of 12 seats of 2 abreast shall be designated as:

Man-riding mine car 2L6-2/12 IS: 9494

Explanation:



8. Tests

8.1 Chassis — If agreed between the purchaser and the manufacturer, the chassis of man-riding cars shall withstand without permanent deformation, one or both of the following proof loads applied gradually at the coupling housing central position.

- a) A tensile load of not less than 190 kN or 2.5 times the maximum static load down the maximum gradient whichever is greater, and
- b) A compressive load of 100 kN.

8.1.1 After proof loading all welds of the chassis shall be examined for cracks preferably by the magnetic particle flow detection method.

8.2 Suspension Units

8.2.1 Routine test — Five samples from each batch of 50 units or from each manufacturing batch, if less than 50, shall be loaded gradually at predetermined steps, to a value not less than the maximum designed load of the suspension units. The deflection on each step shall be measured which shall vary within ± 5 percent and ± 15 percent of the values specified by the car manufacturer for suspension units with steel springs and rubber springs, respectively.

8.2.2 In addition to the above test, the tests if applicable, shall be conducted on suspension units as specified in **8.2.2.1** and **8.2.2.2**.

8.2.2.1 Type test — Each design of rubber spring unit shall be tested as follows to prove the declared load-deflection characteristics:

- a) The test unit shall be conditioned by loading it thrice with the test load, applied as rapidly as possible. The test load shall be not less than twice the normal static load.
- b) The spring unit shall then be loaded gradually with the test load, and the deflections from the free positions shall be noted. The spring unit shall be deemed to comply with the requirements of this standard if the deflections at the static load are within ± 15 percent of the specified deflection at the static load.
- c) Where rubber pads are bonded to steel plates, the load shall be held for not less than 20 seconds. During this period the bond shall be examined which shall not show any sign of defect.
- d) Alternatively, at the option of the manufacturer, the same test may be carried out by using a given deflection.

8.2.2.2 Bend test for laminated springs — Leaves of one sample of spring from a batch of 100 sets of springs or part thereof shall be able to withstand test as specified in Table 3.

8.3 Couplings

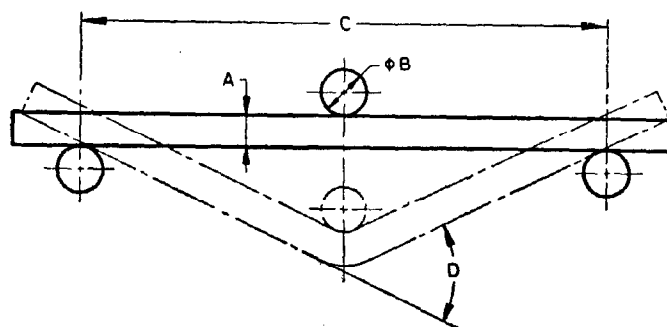
8.3.1 Type test — If required by the purchaser, a prototype of the couplings shall be tested to destruction. The ultimate breaking load shall be not less than eight times the static working load specified by the purchaser.

8.3.2 Proof test — If required by the purchaser all couplings shall be tested to a proof load of 2.5 times the static working load. No coupling shall register permanent extension exceeding three percent in length or permanent deformation exceeding one percent in width.

TABLE 3 DETAILS OF LEAF BEND TEST FOR MAN-RIDING CAR SPRINGS

(Clause 8.2.2.2)

All dimensions in millimetres.



	Thickness of Sample Leaf A	Central Pin Diameter B	Support Centres C	Bend Angle Without Fracture D
Up to and including	9.00	12.00	250.0	35°
			150.0	25°
Over	9.00	20.00	250.0	35°
			150.0	25°

8.3.3 Additional tests (optional) — Where required by the purchaser, and specified in the enquiry and order:

- two sample couplings shall be selected by the purchaser and shall be progressively tested to destruction; and
- magnetic flaw detection testing and radiographic examination shall be performed on the components, and a certificate or report shall be provided to the purchaser.

9. Marking

9.1 Suspension Units Incorporating Rubber — The following details shall be moulded on the rubber elements of the each suspension unit incorporating rubber:

- Manufacturer's identification mark,
- Rated static load in kN, and
- Symbol for date of manufacture of springs.

9.2 Steel springs for Suspension Units — Each spring shall be marked suitably with the following:

- Manufacturer's identification mark,
- Maximum static load in kN, and
- Date of manufacture.

9.3 Each man-riding car shall be fitted with an identification plate which shall be marked with the following information:

- Car manufacturer's name or identification mark,
- Tare weight of the car,
- Designation of the car,
- Safe working load of the chassis of the car, and
- Date of manufacture.

9.3.1 ISI Certification Marking — Details available with the Indian Standards Institution.

10. Painting — The car after assembly shall be descaled, cleaned and painted as agreed between the purchaser and the manufacturer.

10.1 The requirements of 5.1.2 shall apply for the purpose of painting.

APPENDIX A

(Clause 6.6.1.1 and Note 1 under Clause 6.7.1.3)

INFORMATION TO BE PROVIDED WITH ENQUIRY AND ORDER

A-1. When ordering the man-riding cars conforming to the requirements of this standard, the purchaser shall supply the following information:

- 1) Designation of car required (see 7 and Table 1) and maximum number of cars forming the train set.
- 2) Details of any special finish and protective coating required (see 10).
- 3) Limiting dimensions, if any.
- 4) The maximum gradient and minimum radii of horizontal and vertical curves (see Table 1 and Fig. 1 to 4).
- 5) Maximum operating speed.
- 6) Condition of track, that is dry, wet or greasy.
- 7) Materials to be used for the cars (see 5).
- 8) Whether car bodies are to be of welded or riveted construction (see 6.2.1).
- 9) Designation of wheels to be used (see 6.5).
- 10) Type of suspension unit required (see 6.6.1).
- 11) Details of sample testing required (in addition to those of 8).
- 12) If steel laminated springs are required, whether these are to be given anti-corrosion treatment (see 6.6.5.7).
- 13) Type, size and centre height of coupling required (see 6.8).
- 14) Whether a proof test and additional tests on coupling assemblies will be required (see 8.3).
- 15) Whether facilities for inspection, by the purchaser, of assembled couplings are required (see 8.3).
- 16) Type of brakes required, that is, air or hydraulic and/or hand; also whether brake operating gear is required and the location of operating and emergency valves (see 6.7.1.3 and 6.7.2).
- 17) Operating speed(s) on the maximum gradient(s) and the stopping distance(s) required.
- 18) Location and details of any lamp bracket or lighting and/or reflective fittings.
- 19) Whether safety chains or ropes are required.
- 20) Type of hauling system.
- 21) Details of any signalling or communication system required on individual cars or the train.

Note — Where mine waters are highly alkaline or highly acidic it is recommended that the purchaser should notify the manufacturer of this effect, in order that, for instance, the rubber spring compounder may take appropriate action at the time of manufacture.

APPENDIX B

(Clause 6.8.1)

COUPLING DATA

B-1. Rope Haulage — The ultimate tensile breaking load shall be not less than the value obtained from the following formula:

$$L = 78.5 W (\sin \alpha + 0.125 \cos \alpha)$$

where

- L = ultimate tensile breaking load (kN),
 W = dead mass of the train (tonnes), and
 α = maximum angle of track to the horizontal.

B-1.1 For main and tail haulage, although not recommended for man-riding, the strength of the coupling shall be not less than the nominal breaking strength of the strongest rope in the installation.

B-2. Locomotive Haulage — In the case of cars used in conjunction with locomotives, the minimum tensile breaking load of the drawgear of the attached rolling stock shall be not less than twice the mass on the driving wheels of the locomotive, or locomotives, where two are used in tandem for tight couplings, or two and a half times that mass in the case of loose couplings. The minimum tensile breaking load of the drawgear of the locomotive itself shall never be less than two-and-a-half times the mass on the driving wheels of the locomotive, or locomotives, where two are used in tandem.

B-2.1 Tight couplings are any couplings which incorporate spring-type drawgear and which have a designed clearance of not more than 50 mm between the buffing faces.

B-3. General

B-3.1 The couplings shall be designed to have a vertical and horizontal articulation or movement sufficient to meet the conditions of operation as determined from the information supplied by the purchaser.

B-3.2 The components shall be designed to facilitate dismantling, inspection and replacement without recourse to special tools.

B-3.3 The couplings shall be designed to work satisfactorily in wet and dirty conditions and, as far as practicable, be self cleaning in service.

B-3.4 All components of the buffer/couplings shall be designed to operate under conditions of fatigue, due care being taken to reduce the stress raising effect of any changes in section and form. Fillet radii shall as large as possible, to reduce the stress raising effect of the notch.

B-3.5 The purchaser shall supply relevant details of the haulage system, including track layout and methods of haulage, to enable the manufacturer to determine the stress levels that will be imposed on the buffer/coupling. The complete coupling and its components shall be designed to withstand without permanent set the foreseeable loads imposed by the methods of working and the condition and layout of the track.

EXPLANATORY NOTE

This standard covers the requirements regarding man-riding cars used to transport workers to their distant working places in mines. The use of man-riding cars in transportation of workmen ensures the state of freshness and achieves reduction in loss of time consumed by workmen in reaching their worksites which in turn enhances the productivity and the standard of safety in mines.

While preparing this standard considerable assistance has been derived from BS : 4854-1972 'Specification for cars for man-riding in mines' issued by the British Standards Institution.